# Engineering Specification - General Torque Requirements

**DOCUMENT IDENTIFIER:** A-SP-ELMF328-00-0000 Rev B, 24-Feb-1993

**ABSTRACT:** This document specifies torque values for nylon, brass, aluminum, phosphor bronze, and steel screws.

**APPLICABILITY:** The values specified in this document are default values, which apply unless otherwise specified by the applicable engineering drawings.

**STATUS:** Approved 24-Feb-1993; use VTX SMC for current status.

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# 1 INTRODUCTION

This specification tabulates torque values for nylon, brass, aluminum, phosphor bronze and steel screws. Tables 1 through 5 list values for U.S. screw sizes. Tables 6 through 10 list values for metric screws.

## 1.1 SCOPE

The values specified in this document are default values that apply unless otherwise specified by the applicable engineering drawings.

## 1.2 RESPONSIBILITIES

Technical Services for Manufacturing and Engineering (TME) is responsible for the content of this document, and this group must review and approve all proposed changes. Send comments or proposed changes to Steve Spaulding, LUNER::SPAULDING, MLO5-3/B92, DTN: 223-2024.

# 2 GENERAL REQUIREMENTS

When a screw of nylon, aluminum, phosphor bronze, brass, or steel is assembled to a surface of nylon, aluminum, phosphor bronze, brass, or steel, the torque values of this specification shall be used. When the screw and the surface are of the same material, the corresponding table shall be used; when the screw and surface are of different materials, the table for the lesser material shall be used.

For this purpose, nylon is less than aluminum, aluminum is less than phosphor bronze, phosphor bronze is less than brass, and brass is less than steel. Acceptable tolerances on assembly torques are ±20% for threads 10-32 (M4) and smaller, and ±10% for larger threads, for all materials. Assembled fasteners shall be inspected at 80% of the assembly torque, for 10-32 and smaller, and at 90% for larger threads.

**CAUTION**

**Overtightening is as detrimental as undertightening. Improper torque on electrical connections can be a critical defect. It is assumed that a minimum of three full threads are required to develop the full bolt strength.**

# 3 ASSEMBLY

It is recommended that powered screw drivers and nut drivers (electric or pneumatic) be used whenever applicable. Caution should be taken to ensure that these tools are properly matched to the hardware being assembled. Consider the following:

a. Torque capabilities

b. Tool speed

c. Type of clutch

d. Air pressure, regulation, and filtration

e. Calibration

f. Power bits and sockets

## 4 TORQUE VALUES FOR NYLON, U.S. CUSTOMARY UNITS

Use Table 1 when the screw or surface is nylon.

**Table 1: Torque Values for Nylon, U.S. Customary Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Inspection Torque (Inch-Pounds) |
|---|---|---|
| 0-80 | 0.11 ±20% | 0.09 |
| 2-56 | 0.33 ±20% | 0.26 |
| 2-64 | 0.36 ±20% | 0.29 |
| 3-48 | 0.5 ±20% | 0.4 |
| 3-56 | 0.5 ±20% | 0.4 |
| 4-40 | 0.7 ±20% | 0.6 |
| 4-48 | 0.8 ±20% | 0.6 |
| 5-40 | 1.0 ±20% | 0.8 |
| 5-44 | 1.1 ±20% | 0.9 |
| 6-32 | 1.3 ±20% | 1.0 |
| 6-40 | 1.5 ±20% | 1.2 |
| 8-32 | 2.4 ±20% | 1.9 |
| 8-36 | 2.5 ±20% | 2.0 |
| 10-24 | 3.5 ±20% | 2.8 |
| 10-32 | 4.0 ±20% | 3.2 |
| 1/4-20 | 8.4 ±10% | 7.5 |
| 1/4-28 | 9.6 ±10% | 8.6 |
| 5/16-18 | 17.2 ±10% | 15.5 |
| 5/16-24 | 19.0 ±10% | 17.1 |
| 3/8-16 | 30.5 ±10% | 27.5 |
| 3/8-24 | 34.6 ±10% | 31.1 |
| 7/16-14 | 48.8 ±10% | 44.0 |
| 7/16-20 | 55.0 ±10% | 50.0 |
| 1/2-13 | 75.0 ±10% | 65.0 |
| 1/2-20 | 85.0 ±10% | 75.0 |

## 5 TORQUE VALUES FOR ALUMINUM, U.S. CUSTOMARY UNITS

Use Table 2 when the screw or surface is aluminum, and neither screw nor surface is nylon.

**Table 2: Torque Values for Aluminum, U.S. Customary Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Inspection Torque (Inch-Pounds) |
|---|---|---|
| 0-80 | 0.4 ±20% | 0.3 |
| 2-56 | 1.2 ±20% | 1.0 |
| 2-64 | 1.3 ±20% | 1.0 |
| 3-48 | 1.9 ±20% | 1.5 |
| 3-56 | 2.0 ±20% | 1.6 |
| 4-40 | 2.6 ±20% | 2.1 |
| 4-48 | 2.9 ±20% | 2.3 |
| 5-40 | 3.9 ±20% | 3.1 |
| 5-44 | 4.1 ±20% | 3.3 |
| 6-32 | 4.9 ±20% | 3.9 |
| 6-40 | 5.5 ±20% | 4.4 |
| 8-32 | 9.0 ±20% | 7.2 |
| 8-36 | 9.4 ±20% | 7.5 |
| 10-24 | 13.0 ±20% | 10.4 |
| 10-32 | 14.8 ±20% | 11.8 |
| 1/4-20 | 31.0 ±10% | 27.9 |
| 1/4-28 | 35.5 ±10% | 31.9 |
| 5/16-18 | 64.0 ±10% | 58.0 |
| 5/16-24 | 70.0 ±10% | 64.0 |
| 3/8-16 | 115.0 ±10% | 100.0 |
| 3/8-24 | 130.0 ±10% | 115.0 |
| 7/16-14 | 180.0 ±10% | 160.0 |
| 7/16-20 | 200.0 ±10% | 180.0 |
| 1/2-13 | 275.0 ±10% | 250.0 |
| 1/2-20 | 310.0 ±10% | 280.0 |

## 6 TORQUE VALUES FOR PHOSPHOR BRONZE, U.S. CUSTOMARY UNITS

Use Table 3 when the screw or surface is phosphor bronze, and neither screw nor surface is aluminum or nylon.

**Table 3: Torque Values for Phosphor Bronze, U.S. Customary Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Inspection Torque (Inch-Pounds) |
|---|---|---|
| 0-80 | 0.45 ±20% | 0.36 |
| 2-56 | 1.3 ±20% | 1.06 |
| 2-64 | 1.4 ±20% | 1.13 |
| 3-48 | 2.0 ±20% | 1.61 |
| 3-56 | 2.2 ±20% | 1.73 |
| 4-40 | 2.8 ±20% | 2.27 |
| 4-48 | 3.1 ±20% | 2.48 |
| 5-40 | 4.2 ±20% | 3.3 |
| 5-44 | 4.4 ±20% | 3.5 |
| 6-32 | 5.3 ±20% | 4.2 |
| 6-40 | 5.9 ±20% | 4.7 |
| 8-32 | 9.6 ±20% | 7.7 |
| 8-36 | 10.2 ±20% | 8.2 |
| 10-24 | 14.0 ±20% | 11.2 |
| 10-32 | 16.0 ±20% | 13.0 |
| 1/4-20 | 33.4 ±10% | 30.0 |
| 1/4-28 | 38.0 ±10% | 34.0 |
| 5/16-18 | 69.0 ±10% | 62.0 |
| 5/16-24 | 76.0 ±10% | 68.0 |
| 3/8-16 | 122.0 ±10% | 110.0 |
| 3/8-24 | 138.0 ±10% | 124.0 |
| 7/16-14 | 195.0 ±10% | 175.0 |
| 7/16-20 | 218.0 ±10% | 196.0 |
| 1/2-13 | 300.0 ±10% | 270.0 |
| 1/2-20 | 335.0 ±10% | 300.0 |

## 7 TORQUE VALUES FOR BRASS, U.S. CUSTOMARY UNITS

Use Table 4 when the screw or surface is brass, and neither screw nor surface is nylon, phosphor bronze, or aluminum.

**Table 4: Torque Values for Brass, U.S. Customary Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Inspection Torque (Inch-Pounds) |
|---|---|---|
| 0-80 | 0.5 ±20% | 0.4 |
| 2-56 | 1.5 ±20% | 1.2 |
| 2-64 | 1.6 ±20% | 1.3 |
| 3-48 | 2.3 ±20% | 1.8 |
| 3-56 | 2.5 ±20% | 2.0 |
| 4-40 | 3.3 ±20% | 2.6 |
| 4-48 | 3.6 ±20% | 2.9 |
| 5-40 | 4.8 ±20% | 3.8 |
| 5-44 | 5.0 ±20% | 4.0 |
| 6-32 | 6.0 ±20% | 4.8 |
| 6-40 | 6.7 ±20% | 5.4 |
| 8-32 | 11.0 ±20% | 8.8 |
| 8-36 | 11.6 ±20% | 9.3 |
| 10-24 | 16.0 ±20% | 12.8 |
| 10-32 | 18.2 ±20% | 14.6 |
| 1/4-20 | 38.0 ±10% | 34.0 |
| 1/4-28 | 44.0 ±10% | 40.0 |
| 5/16-18 | 79.0 ±10% | 71.0 |
| 5/16-24 | 87.0 ±10% | 78.0 |
| 3/8-16 | 140.0 ±10% | 125.0 |
| 3/8-24 | 158.0 ±10% | 142.0 |
| 7/16-14 | 225.0 ±10% | 200.0 |
| 7/16-20 | 250.0 ±10% | 225.0 |
| 1/2-13 | 340.0 ±10% | 305.0 |
| 1/2-20 | 385.0 ±10% | 345.0 |

## 8 TORQUE VALUES FOR STEEL, U.S. CUSTOMARY UNITS

Use Table 5 when the screw and surface are steel.

**Table 5: Torque Values for Steel, U.S. Customary Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Inspection Torque (Inch-Pounds) |
|---|---|---|
| 0-80 | 0.9 ±20% | 0.7 |
| 2-56 | 2.6 ±20% | 2.1 |
| 2-64 | 2.8 ±20% | 2.2 |
| 3-48 | 4.0 ±20% | 3.2 |
| 3-56 | 4.3 ±20% | 3.4 |
| 4-40 | 6.0 ±20% | 4.8 |
| 4-48 | 6.1 ±20% | 4.9 |
| 5-40 | 8.2 ±20% | 6.6 |
| 5-44 | 8.6 ±20% | 6.9 |
| 6-32 | 10.4 ±20% | 8.3 |
| 6-40 | 11.6 ±20% | 9.2 |
| 8-32 | 18.9 ±20% | 15.2 |
| 8-36 | 20.0 ±20% | 16.0 |
| 10-24 | 27.4 ±20% | 21.9 |
| 10-32 | 31.4 ±20% | 25.1 |
| 1/4-20 | 66.0 ±10% | 59.0 |
| 1/4-28 | 75.0 ±10% | 67.0 |
| 5/16-18 | 135.0 ±10% | 122.0 |
| 5/16-24 | 150.0 ±10% | 135.0 |
| 3/8-16 | 240.0 ±10% | 216.0 |
| 3/8-24 | 272.0 ±10% | 244.0 |
| 7/16-14 | 385.0 ±10% | 345.0 |
| 7/16-20 | 428.0 ±10% | 385.0 |
| 1/2-13 | 585.0 ±10% | 525.0 |
| 1/2-20 | 660.0 ±10% | 595.0 |

## 9 TORQUE VALUES FOR NYLON, METRIC UNITS

Use Table 6 to obtain metric values when the screw or surface is nylon.

**Table 6: Torque Values for Nylon, Metric Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Assembly Torque (Newton-Meters) | Inspection Torque (Inch-Pounds) | Inspection Torque (Newton-Meters) |
|---|---|---|---|---|
| M1.6 | 0.13 ±20% | 0.015 ±20% | 0.11 | 0.012 |
| M2.5 | 0.5 ±20% | 0.06 ±20% | 0.4 | 0.05 |
| M3 | 1.0 ±20% | 0.1 ±20% | 0.8 | 0.08 |
| M3.5 | 1.5 ±20% | 0.17 ±20% | 1.2 | 0.14 |
| M4 | 2.3 ±20% | 0.25 ±20% | 1.8 | 0.2 |
| M5 | 4.6 ±10% | 0.5 ±10% | 4.1 | 0.45 |
| M6 | 7.7 ±10% | 0.87 ±10% | 6.9 | 0.78 |
| M7 | 13.0 ±10% | 1.5 ±10% | 11.7 | 1.35 |
| M8 | 18.8 ±10% | 2.1 ±10% | 16.9 | 1.9 |
| M10 | 37.2 ±10% | 4.2 ±10% | 33.5 | 3.8 |
| M12 | 65.0 ±10% | 7.3 ±10% | 58.0 | 6.6 |

## 10 TORQUE VALUES FOR ALUMINUM, METRIC UNITS

Use Table 7 to obtain metric values when the screw or surface is aluminum, and neither screw nor surface is nylon.

**Table 7: Torque Values for Aluminum, Metric Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Assembly Torque (Newton-Meters) | Inspection Torque (Inch-Pounds) | Inspection Torque (Newton-Meters) |
|---|---|---|---|---|
| M1.6 | 0.5 ±20% | 0.056 ±20% | 0.4 | 0.045 |
| M2.5 | 1.9 ±20% | 0.21 ±20% | 1.5 | 0.17 |
| M3 | 3.6 ±20% | 0.41 ±20% | 2.9 | 0.33 |
| M3.5 | 5.6 ±20% | 0.64 ±20% | 4.5 | 0.51 |
| M4 | 8.4 ±20% | 0.94 ±20% | 6.7 | 0.75 |
| M5 | 16.9 ±10% | 1.9 ±10% | 15.2 | 1.7 |
| M6 | 28.7 ±10% | 3.2 ±10% | 25.8 | 2.9 |
| M7 | 48.0 ±10% | 5.4 ±10% | 43.0 | 4.9 |
| M8 | 70.0 ±10% | 7.9 ±10% | 63.0 | 7.1 |
| M10 | 138.0 ±10% | 15.6 ±10% | 124.0 | 14.0 |
| M12 | 240.0 ±10% | 27.2 ±10% | 216.0 | 24.5 |

## 11 TORQUE VALUES FOR PHOSPHOR BRONZE, METRIC UNITS

Use Table 8 when the screw or surface is phosphor bronze, and neither screw nor surface is aluminum or nylon.

**Table 8: Torque Values for Phosphor Bronze, Metric Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Assembly Torque (Newton-Meters) | Inspection Torque (Inch-Pounds) | Inspection Torque (Newton-Meters) |
|---|---|---|---|---|
| M1.6 | 0.53 ±20% | 0.06 ±20% | 0.42 | 0.05 |
| M2.5 | 2.0 ±20% | 0.23 ±20% | 1.62 | 0.18 |
| M3 | 3.9 ±20% | 0.44 ±20% | 3.1 | 0.35 |
| M3.5 | 6.0 ±20% | 0.69 ±20% | 4.8 | 0.55 |
| M4 | 9.0 ±20% | 1.0 ±20% | 7.2 | 0.8 |
| M5 | 18.2 ±10% | 2.1 ±10% | 16.4 | 1.9 |
| M6 | 31.0 ±10% | 3.5 ±10% | 28.0 | 3.1 |
| M7 | 52.0 ±10% | 5.9 ±10% | 47.0 | 5.3 |
| M8 | 75.0 ±10% | 8.5 ±10% | 67.0 | 7.6 |
| M10 | 150.0 ±10% | 16.8 ±10% | 135.0 | 15.1 |
| M12 | 260.0 ±10% | 29.0 ±10% | 234.0 | 26.0 |

## 12 TORQUE VALUES FOR BRASS, METRIC UNITS

Use Table 9 to obtain metric values when the screw or surface is brass, and neither screw nor surface is nylon, phosphor bronze, or aluminum.

**Table 9: Torque Values for Brass, Metric Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Assembly Torque (Newton-Meters) | Inspection Torque (Inch-Pounds) | Inspection Torque (Newton-Meters) |
|---|---|---|---|---|
| M1.6 | 0.6 ±20% | 0.07 ±20% | 0.48 | 0.056 |
| M2.5 | 2.3 ±20% | 0.26 ±20% | 1.9 | 0.21 |
| M3 | 4.4 ±20% | 0.5 ±20% | 3.5 | 0.4 |
| M3.5 | 7.0 ±20% | 0.8 ±20% | 5.6 | 0.6 |
| M4 | 10.3 ±20% | 1.2 ±20% | 8.2 | 0.9 |
| M5 | 20.8 ±10% | 2.3 ±10% | 18.7 | 2.1 |
| M6 | 35.3 ±10% | 4.0 ±10% | 31.8 | 3.6 |
| M7 | 59.0 ±10% | 6.7 ±10% | 53.0 | 6.0 |
| M8 | 86.0 ±10% | 9.7 ±10% | 77.0 | 8.7 |
| M10 | 170.0 ±10% | 19.2 ±10% | 153.0 | 17.3 |
| M12 | 296.0 ±10% | 33.5 ±10% | 267.0 | 30.0 |

## 13 TORQUE VALUES FOR STEEL, METRIC UNITS

Use Table 10 to obtain metric values when the screw and surface are steel.

**Table 10: Torque Values for Steel, Metric Units**

| Thread Size | Assembly Torque (Inch-Pounds) | Assembly Torque (Newton-Meters) | Inspection Torque (Inch-Pounds) | Inspection Torque (Newton-Meters) |
|---|---|---|---|---|
| M1.6 | 1.0 ±20% | 0.12 ±20% | 0.8 | 0.1 |
| M2.5 | 4.0 ±20% | 0.45 ±20% | 3.2 | 0.36 |
| M3 | 7.6 ±20% | 0.86 ±20% | 6.1 | 0.69 |
| M3.5 | 11.9 ±20% | 1.4 ±20% | 9.6 | 1.0 |
| M4 | 17.7 ±20% | 2.0 ±20% | 14.1 | 1.6 |
| M5 | 35.7 ±10% | 4.0 ±10% | 32.2 | 3.6 |
| M6 | 60.0 ±10% | 6.9 ±10% | 54.0 | 6.2 |
| M7 | 102.0 ±10% | 11.5 ±10% | 92.0 | 10.4 |
| M8 | 147.0 ±10% | 16.7 ±10% | 133.0 | 15.0 |
| M10 | 292.0 ±10% | 33.0 ±10% | 263.0 | 29.7 |
| M12 | 509.0 ±10% | 58.0 ±10% | 458.0 | 52.0 |

## 14 TORQUE CALCULATIONS

Following is an explanation of how torques were calculated for purposes of this specification, and of how U.S. customary units were converted to metric.

Example: Allowable torque for 1/4 – 20 steel screw.

Fi = (SF) (PL) (At)

Fi = Bolt load in lbs.
SF = Safety factor = 0.75
PL = Proof load of steel = 55,000 psi
At = Tensile stress area in sq.in.
(Note: this is a mean value)

Fi = (0.75) (55,000) (0.0318)
= 1,312 lbs.

T = (k) (Fi) (Dn)

T = Allowable bolt torque in inch–lbs.
k = Friction coefficient = 0.2
(Note: Nonlubricated value)
Dn = Nominal screw diameter in inches

T = (0.2) (1,312) (0.250)
= 65.6 inch–pounds

To convert to metric:

T = (65.6 inch–pounds)(0.0254 meters/inch)(4.48 Newtons/pound)

T = 7.5 Newton–Meters

**NOTE**

1. **The proof load for brass = 32,000 psi.**
2. **The proof load for phosphor bronze = 28,000 psi.**
3. **The proof load for aluminum = 26,000 psi.**
4. **The proof load for nylon = 7,000 psi.**

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